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1. DESCRIPTION OF THE *WORKS*

1.1 EXECUTIVE OVERVIEW

Duvha Power Station (PS) has experienced problems with the removal of Water Treatment Plant (WTP) effluent from the effluent sump to the high level ash water return dam. As a result of this, the effluent sump remains full on a continuous basis, and the power station is forced to manage the level by diverting some of the effluent sump contents to the sludge sump. The sludge sump has not been designed to receive effluent of this quality, as the sump is not lined and it has carbon steel pumps and pipelines.

The project seeks to mitigate this problem through the upgrade of the effluent system. The upgrade shall consist of the replacement of all three existing effluent sump pumps, each with a capacity of 125 m^3/hr and the construction of a piping system to cater for the new flow rate within the system.

The *works* is inclusive of all activities necessary for the provision of a fully functional system that meets the *Employer's* requirements. The *Contractor* shall design, manufacture, procure, install and commission all Mechanical, Civil, Electrical, Control & Instrumentation Plant required for the *works* as defined in this technical specification. This shall include interfacing with and utilisation of existing plant and materials. The *Contractor* shall ensure that the complete design shall be performed by an ECSA registered professional engineer/technologist for each discipline as required by the scope of the design.

1.2 *EMPLOYER'S* OBJECTIVES AND PURPOSE OF THE *WORKS*

1.2.1 Background

Wastewater is generated during the production of potable and demineralised water. This wastewater is referred to as effluent, which is defined as water that is contaminated by chemicals and salts. This effluent is sent to the effluent sump from where it is pumped to the high-level ash water return dam for disposal.

The effluent system consists of a 257.55 m^3 sump that is divided into three compartments. Each compartment is equipped with an effluent pump with a 54m^3/h pump capacity. Two of the effluent pumps are available during operation, while the third effluent pump is on standby. The effluent system is designed to automatically start one of the effluent pumps when the sump level is 40% full, and a second effluent pump is started when the sump level is 60% full. These pumps are required to deplete the effluent sump contents until the level is 25% full and then automatically cut off to prevent cavitation of the pumps. In the event that the effluent sump level exceeds 95%, some of the effluent flow is diverted to the sludge sump.

Duvha PS has experienced problems with the removal of effluent from the effluent sump to the high-level ash water return dam. An estimated 259.9 m^3/h effluent flows into the effluent sump during a worst-case scenario. Even with two effluent pumps running, the levels in the effluent sump frequently reach 95% full, which causes effluent to be diverted to the sludge sump. The sludge pumps and pipelines have been corroded as a consequence of the frequent exposure to the effluent.

1.2.2 Objective

The objective of the upgraded effluent system is to ensure that no effluent is diverted into the sludge sump under normal operating conditions and that the effluent sump pumps are not running continuously.

1.3 NORMATIVE / INFORMATIVE REFERENCES

1.3.1 Normative

[1] Duvha Power Station Effluent System Upgrade - Concept Design Report, 382-ECM-AABZ26-RP0000-10, June 2016

[2] Stakeholder Requirements Definition: Upgrade of Duvha effluent system, 382-ECM-MBBZ28-SP0008-2, May 2016.

[3] Required Operational Capability for the upgrade of the effluent system, ECN No: 23345103, 2015.

1.3.2 Informative

[4] Design Review Procedure, 240-53113685.

1.4 INTERPRETATION AND TERMINOLOGY

The following abbreviations are used in this Technical Specification:

Abbreviation	Description
A	Amperes
AKZ	Anlagen Kennzeichnungs System
C&I	Control and Instrumentation
CAD	Computer-Aided Drafting
CoC	Certificate of Compliance
CoE	Centre of Excellence
HAZOP	Hazard Operational Analysis
DCS	Distributed Control System
DCP	Dynamic Cone Penetrometer
ECSA	Engineering Council of South Africa
EDWL	Engineering Design Work Lead
h	Hour
HDPE	High density polyethylene
ITP	Inspection and Test Plan
km	Kilometre
kV	Kilovolt
kW	Kilowatt
LDE	Lead Discipline Engineers
LV	Low Voltage
LPS	Low Pressure Services
m	Meter
mm	Millimetre
m^3/h	Metres cubed per hour

Abbreviation	Description
MV	Medium Voltage
MVA	Mega Volt Amperes
NB	Nominal Bore
NRV	Non Return Valve
OHS	Operational Health and Safety
PS	Power Station
SHE	Safety, Health and Environmental
UV	Ultra Violet
V	Volt
VDSS	Vendor Document Submission Schedule
WTP	Water Treatment Plant
QMS	Quality Management System

2. ENGINEERING AND THE *CONTRACTOR*'S DESIGN

The *Contractor* shall design, procure, supply, manufacture, deliver to site, install, commissions and test the entire w*orks* to ensure a fully functional system. The *works* shall be located at Duvha Power Station, Mpumalanga Province. The *Contractor* shall design the *works* to operate effectively and shall allow for continuous operation, i.e. to operate 24 hours a day and 365 days a year.

2.1 *EMPLOYER*'S DESIGN

2.1.1 Description of the *works*

The *works* consists of the replacement of all three existing effluent sump pumps with three new pumps, each with a capacity of 125 m^3/hr and the construction of a piping system to cater for the new flow rate within the system. The routing of the upgraded pipework shall follow the current system routing as closely as is practical.

The upgraded effluent system shall use the same operating and control philosophy as the current effluent system. The upgraded system shall utilise the cabling, power supply and motors of the current effluent system. The upgraded effluent system shall be controlled by the control and instrumentation design currently in use in the effluent system.

2.1.2 Battery Limits

The battery limits for the *works* are as follows:

2.1.3 Plant Battery Limits

2.1.3.1 Civil, Structural and Mechanical Battery Limits

The inlet to the effluent sump shall be one of the project terminal points. A further terminal point shall be defined at the point where the pipeline from the effluent sump enters the sludge sump. The final terminal point shall be at the point where the pipeline from the effluent sump enters the high-level dam.

2.1.3.2 Electrical Battery Limits

The electrical battery limits start from the existing 400V Water Plant Board 1A and 400V Water Plant Board 2A including cabling and terminate at the existing effluent plant motors (30kW, 56A).

The *Contractor* shall ensure that the upgraded pumps are compatible to the existing motors (30kW, 56A) and provide termination to these motors.

2.1.3.3 Control & Instrumentation Battery Limits

The C&I battery limits start from the existing sump level measurements (10 UH21L001, 10UH21L002 and 10UH21L003) and terminate at the WTP DCS to the switchgear.

2.1.4 Drawings

The following drawings are made available as information for the current system:

- 0.57/58521 Sheet 1 Duvha Power Station Effluent Water System General Arrangement (see Appendix C).

- 0.57/58521 Sheet 2 Duvha Power Station Effluent Water System General Arrangement Detail 1 Isometric Dimensions (see Appendix B).

2.1.5 *Works* Operating and Control Philosophy

The upgraded effluent system shall use the same operating and control philosophy as the original effluent system. Two of the effluent pumps are available during operation, while the third effluent pump is on standby. The effluent system is designed to automatically start one of the effluent pumps when the sump level is 40% full, and a second effluent pump is started when the sump level is 60% full. These pumps are required to deplete the effluent sump contents until the level is 25% full and then automatically cut off to prevent cavitation of the pumps. In the event that the effluent sump level exceeds 95%, some of the effluent flow is diverted to the sludge sump.

2.1.6 *Employer's* Engineering Design

2.1.6.1 Control and Instrumentation Design

The upgraded effluent pumps shall be interfaced with the existing WTP effluent plant control system. Nothing shall be changed or upgraded from the existing effluent C&I infrastructure.

2.1.6.2 Civil and Structural Design

Each existing pump is supported by a 1320mm x 620mm steel base plate fixed onto the existing concrete slab. Each base plate supports a pump and a motor. The current base plates have deteriorated over time.

A 100mm diameter pipeline (approximately 1.6km) runs from the pumps to the high-level ash water return dams as shown in drawing No. 057/58521 Sheet 1 (see Appendix C). The existing pipeline is made of carbon steel and HDPE sections.

2.1.7 *Works* Life-expectancy

The design life of the *works* is until 2046.

2.2 PARTS OF THE *WORKS* WHICH THE *CONTRACTOR* IS TO DESIGN

The *Contractor* shall ensure that the complete design shall be performed by an Engineering Council of South Africa (ECSA) registered professional engineer/technologist as required by the scope of the design.

The *Contractor* shall be responsible for carrying out all activities and supplying all that is necessary to provide the *works* in accordance with the requirements of the *works* Information.

The *Contractor* shall be required to perform a plant walk down and evaluates items described in the *works* for inclusion in tender submission. The *Contractor* shall be required to develop a detailed design report for acceptance.

The *Contractor* shall be responsible for the design, manufacture, procurement, delivery to site, off-loading, erection, installation, site testing and commissioning of all Plant and Material required to ensure a fully functional system.

The *Contractor* shall conform to all of the standards listed in Section 4.

2.2.1 Scope of the *work*

The scope of *work* describes the major activities and plant and material that falls within the scope of the *Contractor*. The *Contractor* shall be responsible to ensure that all the activities are carried out and all equipment, plant and materials are supplied to complete the *works* in every respect.

(1) The *works* comprises the following:

a) Detail Design

b) Manufacture and procurement

c) Delivery to and offloading at site

d) Installation

e) AKZ labelling

f) Corrosion and Ultra Violet (UV) protection

g) Interfacing with existing plant

h) Commissioning, testing and optimisation

i) Training of *Employer*'s personnel in the operation and maintenance of the system

j) Documentation as specified

k) Quality management for all activities

l) Safety and plant signage

m) Storage on site

n) HAZOP study

(2) All plant, material and equipment is required to be designed for operation in a power plant environment with a minimum requirement for maintenance and operator intervention.

(3) It is not the intention of this scope of work to describe in detail all the activities the *Contractor* shall be required to carry out, nor to describe in detail everything to be supplied by the *Contractor*.

(4) The *Contractor* shall design according to the requirements of this Technical Specification.

(5) The *Contractor*'s design is required to be accepted before any site work or procurement of plant and materials begins.

2.2.2 *Contractor's* scope for the operating, control and maintenance philosophy

The *Contractor* shall be responsible for the provision of a detailed operating and control philosophy as per the *Contractor*'s detailed design of the *works* and submits this to the *Project Manager* for acceptance prior to commencing with the construction activities.

The *Contractor* shall provide a detailed maintenance philosophy for the plant which includes a preventative maintenance plan for the plant as a whole and for each component within the plant. The *Contractor* shall provide a critical spares list for the *works*. The *Contractor* shall also provide the necessary periodic maintenance inspections required for the plant together with the maintenance philosophy.

2.2.3 General Design and Manufacturing Process Constraints

The *Project Manager* reserves the right to carry out any checks of his/her own on any plant, equipment and materials that have been delivered to site for the *works*.

The *Contractor* shall be fully responsible for the interfacing and tie-ins with existing plant and equipment.

2.2.4 Engineering Design Phase

The *Contractor* shall provide the detailed design for the *works* to the *Project Manager* for acceptance prior to procurement of the plant and materials. The *Contractor* shall only proceed with procurement of the plant and materials once the *Project Manager* has accepted the detailed design provided by the *Contractor.*

The design of the upgraded effluent system that forms part of the design for the *works* shall conform to the following requirements:

2.2.4.1 Mechanical Design

2.2.4.1.1 Design basis for the three upgraded pumps

The *Contractor* shall:

- Provide a hydraulic simulation as part of his detailed design package.
- Remove the existing installed pumps.
- Supply and install the upgraded effluent pumps #1, #2 and #3 that conforms to the specification detailed in the technical data sheet provided in Appendix D.
- Supply and install a new base plate with drainage gutter for all three upgraded effluent pumps, coated with a protective coating in accordance with the *Employer*'s corrosion protection specification.
- Supply and install the discharge and suction valves for all three effluent pumps.
- Supply and install of the suction and discharge non-return valves for all three effluent pumps.
- Supply and install the 300-micron stainless steel mesh for the suction strainer for all three pumps.
- Supply and install the pump priming pipework for all three pumps.
- Supply and install the local pressure gauges for suction and discharge pipework.

2.2.4.1.2 Design basis for Valves

The *Contractor* shall produce a valve schedule and data sheet on completion of the system design and submit it to the *Project Manager* for acceptance.

The *Contractor* shall comply with the following minimum requirements:

- All valves are required to be arranged and positioned at accessible locations to ensure safe, efficient and easy operation and maintenance. The *Contractor* shall provide clear access to the valve hand wheels and avoids valve hand wheels being tucked behind other valves or components.
- All valves are required to be of approved design and manufacture and those of similar size, make, and duty shall be interchangeable with one another.
- The face of each hand wheel is required to be clearly marked with the words “OPEN” and “SHUT’ with relevant direction arrows adjacent to it.
- The *Contractor* shall supply the following minimum valve information to the *Employer:*
    - Recommended spares list (with full technical specification details).

- Valve assembly and dis-assembly procedure.
- Maintenance procedure.

- The contractor shall supply and install the effluent sump interconnection lifting liner valves

The *Contractor* shall ensure that local support for the valves; spares availability and short lead times in cases of emergency are available.

Employer prefers wafer type butterfly valves for purposes of isolation. Where the *Contractor* specifies valves not preferred by the *Employer*, it may be accepted by the *Employer* if the valves are a locally supplied product. An application for the deviation shall be submitted to the *Project Manager* for approval.

- All valves are required to be manually operated.
- All manual valves shall be lockable.
- All valves are required to be for isolation purposes only, no control shall be needed, and vent valves, including non-return valves shall need to be installed.
- All valves are required to be new and compatible for use with the stainless steel pipes.

2.2.4.1.3 Design basis for Pipes

The first section of pipes shall be constructed of stainless steel as indicated on the drawing 0.57/58521 SHT 2 (see Appendix B) and the remaining section shall be required to be UV resistant High density polyethylene (HDPE), the sizes and schedule are detailed in Table 1 (see Appendix A).

The design of the pipelines shall conform to the following:

- The total upgraded pipeline distance shall be verified by the *Contractor*. The approximate distance is 1.6 km.
- The *Contractor* shall design according to the pipeline details provided in Appendix A.
- The stainless-steel section of the upgraded pipeline shall correspond to the length of the carbon steel pipeline section of the existing effluent discharge pipeline. The carbon steel section of the existing effluent pipeline is estimated to be 100m. The *Contractor* shall verify and cater for the length of stainless-steel piping required.
- The UV resistant HDPE section of the upgraded pipeline shall correspond to the length of the HDPE section of the existing effluent discharge pipeline. The HDPE section of the existing effluent pipeline is estimated to be 1.5 km. The *Contractor* shall verify and cater for the length of UV resistant HDPE piping required.
- The above ground section of the UV resistant HDPE section of the upgraded pipeline shall correspond to the above ground length of the HDPE section of the existing effluent discharge pipeline. The above ground HDPE section of the existing effluent pipeline is estimated to be 700 m. The length of the above ground UV resistant HDPE section of the upgraded effluent pipeline shall be verified and catered for by the *Contractor.*
- The buried section of the UV resistant HDPE section of the upgraded pipeline shall correspond to the buried length of the HDPE section of the existing effluent discharge pipeline. The buried HDPE section of the existing effluent pipeline is estimated to be 800 m. The length of the buried UV resistant HDPE section of the upgraded effluent pipeline shall be verified and catered for by the *Contractor.*
- The existing effluent discharge pipeline re-emerges above ground in the vicinity of the high-level ash water return dam, in which the effluent is disposed of. The length of the pipe for this above ground section shall be verified and catered for by the *Contractor*.

The *Contractor* shall submit the pipe data sheets and pipe schedule and complete design to the *Project Manager* for acceptance.

The *Contractor*'s design verifies and ensures the integrity of all pipe work. The materials of construction for the pipework shall be suitable for the effluent water and environment they are in contact with.

Pipes shall be equipped with vent valves for purging of air during start-up.

The *Contractor* shall mark all pipe work associated with the *works* with the description of the medium and direction of flow clearly displayed and visible from a normal operating perspective, in accordance with the *Employer*'s specification ESKSCAAC6-0 (Specification for the identification of the content of pipelines and vessels).

2.2.4.2 Civil Design

The *Contractor* shall assess all structural supports and ensure that the supports have sufficient capacity to carry the new loads as a result of the upgrade of pumps and pipelines. Should the supports not have sufficient capacity, the *Contractor* shall be required to design a modification for the supports or replace the supports with new structures that meet the load requirements. The supports include the pump base plates, supporting ground slab and the pipeline supports.

The existing pumps are supported by a 1320mm x 620mm steel base plate fixed onto the existing concrete slab. Three upgraded pumps are to be installed, and therefore the base plates shall be designed for the new pumps by the *Contractor*. Each base plate shall support a pump and a motor. The current base plates have deteriorated over time and shall therefore be removed and replaced to accommodate the upgraded pumps.

The upgraded pipeline shall run from the upgraded effluent pumps to the high-level ash water return dam as shown in drawing No. 057/58521 Sheet 1 (see Appendix C). The upgraded pipeline shall be made up of the following sections:

1. Stainless steel: The stainless-steel section shall run above ground as stated in Section 2.2.4.1. Due to the replacement of the existing 100 mm diameter pipeline to a new 200mm diameter pipeline, the supports structures shall be assessed and modified in accordance with the requirements set out in Sections 2.2.4.2.1 & 2.2.4.2.3 below.
2. UV resistant HDPE: The UV resistant HDPE section shall run as stated in Section 2.2.4.1. The above ground section shall continue concrete sleepers and steel brackets. The buried section of the pipeline shall run underground and shall emerge in the vicinity of the high-level ash water return dam. New supporting structures shall be provided for the upgraded pipeline in accordance with the requirements set out in Sections 2.2.4.2.1 & 2.2.4.2.3 below.

2.2.4.2.1 Civil Scope

The design process shall follow the Structural Design and Engineering Standard 240-56364545, the steps below shall outline the deliverables specified:

1. Three base plates shall be designed to support the pumping system. The base plates shall be mounted on the existing concrete slab by means of anchor bolts.
2. The *Contractor* shall perform adequate calculations and design checks to show that the existing supports supporting the steel pipe section can carry the additional forces imposed by the new line. In the case where the supports are not adequate for the new load, the *Contractor* shall design for the additional supports or modify the existing supports to support the new loads.

3. New supports shall be designed for the UV resistant HDPE section that is currently supported by steel brackets. The same or similar supports shall be designed along the existing line as shown by drawing No. 0.57/58521 Sheet 1 (see Appendix C).
4. The upgraded line shall go below ground at approximately the same point where the old line is going underground.

2.2.4.2.2 Design Requirements for Pump Supports

1. The new base plates shall be designed to support the total mass of the upgraded pumps and motors and to accommodate all of the forces that shall be exerted onto them by the motors and pumps.
2. Base plate support shall be analysed according to the pump loading calculations performed by the *Contractor*. All designs shall comply with the Eskom Standard 240-56364545 “Structural Design & Engineering Standard.
3. The *Contractor* shall conduct a structural analysis to ensure that the concrete slab that supports the pumps has sufficient capacity to support the forces from the upgraded pumps.
4. All calculations and structural analyses performed shall be submitted to the *Project Manager* for acceptance.

2.2.4.2.3 Design Requirements for Pipe Supports

1. The design and calculations of the pipe supports shall be based on Eskom Standard 240-56364545 “Structural Design & Engineering Standard”
2. All piping and valve hangers, brackets and supports shall be arranged in such a manner that they do not obscure the view of any instrumentation or obstruct safe and normal access.
3. All metal surfaces of pipe supports are hot dip galvanised to ensure sufficient resistance to corrosion is provided.
4. All welds are designed in accordance with SANS 10162
5. Above ground UV resistant HDPE piping is placed on a continuous support structure which is supported by structural members, to prevent pipe bending. The *Contractor* shall conduct calculations to determine the forces acting on the structural members from moving and from stationary effluent in the pipeline. Forces acting on the structural members and the spacing thereof need to be determined and designed for.
6. The *Contractor* shall be responsible for all sub surface investigations and shall include in his price, all the costs associated with the sub surface investigation and appropriate laboratory & field tests necessary to determine the geotechnical properties of the sub soil to withstand all loading conditions imposed.
7. The *Contractor* shall seek acceptance of the detailed design from the *Project Manager* for the applicable design
8. Only drawings and designs accepted by the *Project Manager* shall be used for construction

2.2.4.2.4 Design Requirements for buried pipes

1. The trench designs shall be performed to the following design standards; SANS 10102-1&2.
2. The installation conditions shall be selected based on the conditions of site as outlined in the SANS 10102-1&2. Bedding class shall be made or selected in accordance with SANS 2001 LB. The installation or burying of the pipe shall be such that the load distribution is achieved as close

to hydrostatic loading as possible. The installation procedures used during construction shall not compromise the design.

3. All backfilling shall be completed as outlined in SANS 10102, as per the *Contractor's* design specification and for acceptance by the *Project Manager.*
4. The *Contractor* shall ensure that the *works* does not interfere with the existing sub surface services. To ensure this, the *Contractor* shall conduct a geophysical testing to locate all existing services along the route of the new line.

2.2.4.3 Geotechnical Investigation Scope of *works*

A geotechnical investigation is required for the proposed pipeline route (see drawing No. 057/58521 Sheet 1 in Appendix C). The existing HDPE pipeline route consists of the following sections:

- Section 1 – Above ground supported by concrete sleepers
- Section 2 – Above ground supported by steel brackets
- Section 3 – Buried
- Section 4 – Above ground supported by steel brackets

The Study is required along Sections 2, 3 and 4, which constitute an approximate length of 1.4km. The *Contractor* shall verify the length of Sections 2, 3 and 4 for the Study.

The new pipeline shall run alongside the existing pipeline route. Therefore, the geotechnical investigation shall need to occur in 2 (two) phases.

The first phase of the geotechnical investigation shall comprise of geophysical testing to determine the above ground and sub-surface route. The second phase of the geotechnical investigation shall comprise of in-situ and laboratory tests for the design of pipeline supports for the upgraded pipeline route. The upgraded pipeline size is 200NB.

A site walk down is required prior to the commencement of testing. The purpose of this activity shall be to determine a proposed testing layout taking into account possible access restrictions for required plant equipment. The viability of the identified testing locations shall be confirmed based on the results of the geophysical testing. The site walk down is attended by the *Contractor* and the *Employer*.

The scope of work for the proposed geotechnical testing including report writing is outlined below.

The *Contractor* shall make written recommendations to the *Project Manager* should he/she be of the opinion that further or additional tests may be necessary in order to fulfil the requirements of the scope.

2.2.4.3.1 Desktop Study

1. The *Contractor* shall conduct a desk study review of all available existing geotechnical information and regional geological information available for the proposed testing areas.

2.2.4.3.2 Geophysical Testing

1. Geophysical tests are adopted to locate the sub-surface pipeline route for the UV resistant HDPE section of the pipeline as set out in Section 2.2.4.1.
2. Geophysical tests are adopted to determine the above ground route for the UV resistant HDPE section of the pipeline as set out in Section 2.2.4.1.
3. Geophysical Testing shall be implemented to a depth of 3-5 metres.

4. Prior to implementation of geophysical testing, the *Contractor* shall conduct a site walk-over to determine if the ground conditions shall be conducive to the type of geophysical testing selected.
5. The *Contractor* shall make a written recommendation to the *Project Manager* should he/she be of the opinion that the Geophysical tests be implemented to a greater depth than is outlined in the scope.
6. The Geophysical testing is implemented through the proposed above ground and sub-surface route (See drawing No. 057/58521 Sheet 1 in Appendix C)

Geophysical testing shall aim to minimize the *Employer's* risk by onset mitigation against intersection of existing underground services.

All Geophysical test findings shall be confirmed by hand excavation (where applicable).

The geophysical test results shall determine the depth of test pits for the sub-surface and above ground pipeline.

2.2.4.3.3 Test Pitting

1. Excavation and supervision of a maximum of 6 (six) test pits.
2. The number of test pits may be amended upon assessment of the ground condition.
3. Test pits for the proposed 600m above ground pipeline route are excavated to a maximum depth of 3m or as determined by the geophysical testing results
4. Test pits for the proposed 800m sub-surface route are excavated to a depth as determined by the geophysical testing results.
5. All test pits are profiled by a professionally registered engineering geologist/geotechnical engineer according to "Guidelines for Soil and Rock Logging in SA, 2nd Impression" (Brink and Bruin, 2002).
6. All test pits are reinstated using soils removed from pits following completion of soil profiling and sampling.

The *Project Manager* reviews and accepts the proposed test pit layout prior to excavation.

No personnel shall enter test pits of equal or greater than 1.2m depth.

2.2.4.3.4 Dynamic Cone Penetrometer (DCP)

1. DCP tests are conducted along the entire proposed 1.4km pipeline route.
2. A maximum of 6 (six) DCP tests are conducted.
3. DCP tests are conducted adjacent to test pit excavations and aim to delineate the overall ground stiffness profile.
4. DCP tests results shall be evaluated by the *Contractor* and used to determine Estimated Allowable Safe Bearing Capacity (EASBP) of the ground in 300mm intervals.

2.2.4.3.5 Tests on Soil Samples

1. 3 x Foundation Indication with Hydrometer
2. 3 x Oedometer
3. 3 x Double Oedometer

4. Youngs Modulus
5. Poissons Ratio

2.2.4.3.6 Reporting Deliverables

1. After completion of fieldworks and laboratory testing, the *Contractor*'s professional engineering geologist or geotechnical engineer shall prepare and submit a consolidated geotechnical report.
2. Factual information and interpretive results shall be clearly distinguished.
3. All assumptions shall be included.
4. All field/raw data, laboratory data and calculation files shall be included within the appendices.
5. The geotechnical report shall include:
   a) Site Location
   b) Site Description
   c) Project Description
   d) Regional Geology
   e) Local Geology and Geohydrology
   f) Description of the fieldwork including equipment
   g) Surface and Sub-surface conditions as determined by the fieldwork and laboratory testing
   h) Classification and description of all properties pertinent to the soil profile
   i) Discussions and calculations of allowable bearing capacities and settlements (where applicable)
6. Recommendations regarding the required pipe supports for the for the pipeline sections as set out in Section 2.2.4.1.

2.2.4.4 Electrical Design

The *Contractor* is responsible for designing procurement, manufacture, transportation, delivery, offloading, commissioning, testing. The required absorbed mechanical power requirements are given as 23kW, 40A each while the existing installed motors are rated 30kW, 56A each. The existing switchgear feeders and protection circuits (fuse switch: 125A) including cables (95mm^2) were sized based on the 30kW, 56A motors. Therefore, the required upgrade for the effluent system shall not have an impact on the existing electrical network. The currently installed effluent plant motors (30kW, 56A) are fed from the 400V Water Plant Boards 1A and 2A respectively.

The *Employer* will provide the three existing effluent pumps circuits to the *Contractor*. The *Contractor* must retain the current protective equipment, such as power fuses, cables etc unless it jeopardizes the protection of the new effluent pump motors. If deemed necessary, the *Contractor* to resize both power circuit and control circuit components to accommodate the new motors. The *Contractor* shall provide the type tests results of all the motors to be installed prior to delivering the motor to site. The type test results shall be sent to the *Employer* for approval after the *Employer* has witnessed the test in the *Contractor's* workshop or any place that is recommended by the *Contractor.* All electrical drawings shall be prepared/drawn by the registered the professional ECSA electrical technologist/engineer. The *Employer* is responsible for taking the permits for the *Contractor* to be able to work on the isolated boards. All the modification drawings shall be sent to the *Employe*r prior to commence of the work by the *Contractor* for approval.

The following circuits need to be modified:

1) 380V WTP board 1A: Effluent sump pump standby 2 Circuit Number 17
2) 380 WTP board 1A: Effluent sump pump 1 Circuit Number 18
3) 380 WTP board 2A: Effluent sump pump 3 Circuit Number 21

As per 240-57617975 standard the following information shall be submitted to the *Employer* for a review and approval prior to scheduled delivery:

a) A copy of installation, operating and maintenance manual, Information contained in this manual shall include but not limited to:

-Installation instructions

-Operating instructions, including starting limitations

-Maintenance requirements and data

-Instructions on how to completely dissemble and assemble the motor for major inspections, repairs and overhauls.

-Replacement parts catalogue

-Storage requirements

-Trouble shoot guide

b) Required type test certificates and routine certificates

c)Signed Torque vs speed curves and current vs speed curves, Signed efficiency and power factor vs load curves.

No manufacturing or delivery of motors should be allowed before the designs are finalised and accepted by the *Employer.*

2.2.4.5 Control and Instrumentation Design

The *Contractor* shall ensure that:

The upgraded effluent pumps shall be interfaced with the existing WTP effluent plant control system. Nothing shall be changed or upgraded from the existing effluent C&I infrastructure.

2.2.4.6 Method of Construction

The existing effluent system cannot be decommissioned until the system upgrade has been constructed, since it is integral to the operation of the entire Power Station. As such, the *Contractor* shall be required to submit a detailed constructability assessment of how to carry out the *works* to the *Project Manager*. The following construction methodology is suggested by the *Employer*:

The upgraded effluent system pipework shall be installed in parallel to the current effluent system pipework routing. The installation of the new pipework shall not interfere with the operation of the current effluent system line to ensure that system downtime is avoided.

The effluent system has three base plates at the effluent sump upon which three effluent sump pumps were designed to be located. The system currently has one working pump and the remaining two base

plates are vacant. Two of the upgraded pumps shall be installed on the vacant base plates without interfering with the operation of the single original pump.

Once the new pipework and the two upgraded pumps have been installed and connected, the single original pump shall be switched off. The two upgraded pumps shall then start operating. The original effluent system pump and piping system shall then be decommissioned. Once the original effluent pump is removed, the third upgraded pump shall be installed and connected to the common effluent system pipeline.

2.2.5 *Works* Function and Performance Requirements

The upgraded effluent system shall transfer all WTP effluent to the high level ash water return dam with the following performance requirement:

- The effluent pumps shall not run continuously.
- The level in the effluent sump shall not reach 95%
- A peak flow into the effluent system of 259.9 m3/h

2.2.6 General Design Requirements

1. In designing the *works*, the *Contractor* shall take due cognisance of existing plant and materials as well as safety and housekeeping constraints. The *Contractor* shall be responsible to overcome any issues that may arise due to space constraints with prior consent from the *Project Manager* and no extra payment or claim of any kind shall be allowed on account of difficulties of access to the *works* or for the requirements of working adjacent to or in the same area as others. The *Contractor* shall provide adequate working space for all new plant and existing plant for inspection, testing, operating and maintenance purposes.
2. The *Contractor* shall be responsible for integrating his design with the existing installed plant and equipment. The *works* shall comply with best professional engineering practices. The *works* shall be designed for the environmental conditions prevailing at Duvha Power Station.
3. The *Contractor* shall list all the consumable components that form part of the *works*, specify each component's life and include it as part of the design package.
4. All Plant and Materials used for process control shall be constructed of suitable material so that no corrosion or erosion by chemicals can occur, by virtue of its installation in the process.
5. The *Contractor* shall provide all relevant welding procedures for acceptance by the *Project Manager*.

2.2.7 Design Review

1. The design documentation shall be submitted to the *Project Manager* for acceptance.
2. All design work shall be signed and approved by the applicable Professional Engineer (mechanical, electronic, electrical, chemical, civil etc.) responsible for their preparation before being submitted to the *Project Manager*.
3. The *Contractor* shall submit detailed Technical Data Sheets of all mechanical equipment used for the *works* to the *Project Manager* as part of the design.
4. Acceptance of the design by the *Project Manager* shall not relieve the *Contractor* of his liability for his design and drawings.

2.2.8 HAZOP Study

The *Contractor* shall conduct a HAZOP study with the participation of the *Employer's* representatives prior to commissioning of the system. Upon completion of the study the HAZOP report shall be issued to the *Employer* for review. The study shall be performed in accordance with the Hazard and Operability Analysis (HAZOP) Guideline (240-49230111).

The *Contractor* shall cater for any additions to his design based on the outcomes of the HAZOP.

2.3 PROCEDURE FOR SUBMISSION AND ACCEPTANCE OF *CONTRACTOR*'S DESIGN

The *Contractor* shall establish a document tracking system to record the dates for the supply and receipt of all design drawings, calculations, requests for information and design documentation.

The *Contractor* shall supply the following documentation as the minimum requirements of this specification in the design package before any manufacturing, construction or commissioning commences:

- Document submittal schedule indicating when all documents shall be submitted.
- Drawing Register indicating when drawings shall be submitted.
- Complete detailed design file
- Functional Specifications
- Line Sizing Calculations and Material Selection
- Final isometric and general arrangements illustrating pipe dimensions, pipeline layouts and showing pipe supports.
- General Arrangement Drawing of System and boundaries (for the plant, control panel for trace heating and electrical panel)
- As-built Drawings
- Piping and Instrument Diagrams
- Component material datasheets
- Constructability Assessment
- Quality Control Procedures
- Quality Control Plan and Inspection and Test Plan
- Method Statements
- Commissioning procedures
- Assembly procedures
- Technical, Operation and Maintenance Manuals of all plant equipment
- Operating and Control Philosophies
- Maintenance Philosophy
- Maintenance schedules
- System curves and pump curves
- Updated P&ID's with AKZ coding

- Field termination drawings
- Pipeline Schedule
- Instrument schedule
- Drive and Actuator Schedules
- Mechanical Hook-up diagrams
- Electrical Hook-up diagrams
- LOSS diagrams
- Alarm list
- Electrical cable schedules
- Electrical termination schedules
- Valve datasheet
- Schematics for the electrical design
- Critical Spares List
- Welding Procedure Specifications
- Welding Procedure Qualification Record
- Operating, Maintenance and Engineering Training Manuals
- The *Contractor* shall seek acceptance of the detailed designs from the *Project Manager*
- Only drawings and designs accepted by the *Project Manager* shall be used for construction.

2.4 OTHER REQUIREMENTS OF THE *CONTRACTOR*'S DESIGN

2.4.1 Physical Characteristics Requirements

The *Contractor* shall ensure that the design of the system is consistent throughout; such as valves, pumps and tanks, where applicable. All equipment shall be protected from external ingress, corrosion and explosion proof where applicable.

2.4.2 Fire Protection

Precautions are taken to prevent any occurrence of fires or explosions while carrying out any work near the gas and fuel oil systems.

The *Contractor* shall provide a fire risk analysis as part of the design approval process to the *Project Manager* for approval. The *Contractor* shall implement the protection measures required to mitigate the risks identified in the fire risk analysis.

2.4.3 Corrosion protection

Equipment is adequately protected from physical damage and corrosion during storage and erection.

The corrosion protection of equipment and steelwork shall comply with a standard and the *Employer* shall reserve the right to verify the quality control on completion of the corrosion protection.

2.4.4 Testing and Commissioning

Testing and commissioning shall include as a minimum:

a) The services of skilled Engineers to supervise the testing and commissioning and making ready for the operation of the *works* as required for partial and full duty operation as described in Section 3.2.

b) All management, supervision, labour, tools, instruments, chemicals, test apparatus, calibration equipment and any other equipment and facilities as may be necessary.

The *Contractor's* preliminary trials and commissioning of the *works* shall be carried out by the *Contractor's* representatives, who shall remain in attendance until such time as the *works* are working to the *Employer's* satisfaction. A requirement of these trials is one 72-hour test period to determine that all activities as laid down in the operating manuals are correct and are carried out in the correct sequence and to determine that all the plants have been provided as required in the scope of *work*.

The operating and maintenance manuals shall be submitted at least 2 weeks prior to the start of commissioning for acceptance by the relevant *Employer's* representative. The *Contractor* shall supply all data books with signed ITPs and as build drawings of the *works*.

Commissioning of the system shall be done by the *Contractor's* staff with the *Employer's* dedicated operations/commissioning staff.

The *Contractor* shall submit a commissioning schedule and program for acceptance by the *Project Manager* by the contract date.

Before plant and equipment is placed in service the *Contractor* shall certify that it is in a suitable and safe condition. In addition, the *Contractor* shall provide a complete list of numbered schematic, wiring and cable diagrams which are a true record of the plant and equipment as installed and certifies that the system has been wired in accordance with these diagrams.

Prior to the time when commissioning is to commence, the *Project Manager* shall appoint a representative who shall co-ordinate the commissioning of all plant and equipment forming an integral part of the system being commissioned. The *Contractor* shall be responsible for the commissioning of all the plant and materials he/she shall supply to the requirements of this specification to the satisfaction of the *Project Manager* and the *Employer*'s representatives. Where various components are already in place, or are supplied by the *Employer* to form an integrated system, the *Contractor* at the time of commissioning, shall carry the responsibility for the correct functioning of the whole system.

In the event of incorrect functioning, the *Contractor* shall determine the cause and shall correct the defect if the defect is within plant and equipment of his/her own supply. The *Contractor*, at the time of commissioning, has the agreement, or alternatively, the attendance of the *Project Manager* involved in a particular phase, before proceeding with commissioning. Consequently, the *Contractor* shall assure himself/herself as to the safety of his/her own plant and equipment in respect of any particular commissioning test and in the event of damage accept responsibility for such plant and equipment.

2.5 USE OF *CONTRACTOR*'S DESIGN

The completed design when completed shall become the property of the *Employer*.

2.6 PLANT AND MATERIAL REQUIREMENTS TO BE INCLUDED IN THE *WORKS*

The *Contractor* shall prepare and submit a project Inspection and Test Plan (ITP) for all plant and materials included in the scope. The project ITP shall detail all elements of the plant and shall itemize the required quality levels for each of these components.

The *Contractor* shall indicate in the project ITP which items are of a proprietary nature where the level of certification is limited to standard documentation and certificates of conformity. The *Contractor* shall use only ISO 9001 accredited suppliers for these products. Evidence of ISO 9001 certification shall be supplied with the delivery documentation. Failure to include this certification at the time of delivery shall result in rejection of the plant and materials by the *Employer*.

2.7 AS-BUILT DRAWINGS, OPERATING MANUALS AND MAINTENANCE SCHEDULES

1. All as-built drawings, operating manuals and maintenance schedules shall be available to the *Employer* as soon as the plant is ready for commissioning. All drawings and reports compiled for the *works* are to become the property of the *Employer* on completion of the *works*.
2. The *Contractor* shall ensure the following:
    a) Makes use of a system compatible with the *Employer*'s Microstation (Version 8) CAD for all drawings supplied to the Employer in electronic medium (e.g. disks) in addition to prints. Additionally, all drawings shall be supplied in Adobe PDF format.
    b) Implements and maintains an updated drawing register, the format of which shall be submitted to the Project Manager for acceptance. Updates are submitted on a regular basis or when significant changes are made.
3. The *Contractor* shall submit detailed drawings of all the separate items of the *works* included in the specification for acceptance once the general arrangement drawings have been accepted. If *works* or materials are supplied before such acceptance has been given, the *Contractor* shall modify or replaces such *works* or material at his own expense if called upon by the *Project Manager* to do so.
4. Submit four prints of all “as built” drawings with approval signatures at Completion by the ECSA registered professional engineer for each discipline as required by the design, backed up on the electronic medium, without delay on request by the *Project Manager*.

2.8 TECHNICAL, OPERATING AND MAINTENANCE MANUALS

The *Contractor* shall provide good quality operating and maintenance manuals prepared by suitably experienced personnel. The maintenance manuals shall state explicitly the maintenance requirements for each piece of equipment. Copies of the first draft manuals as well as all “as built” drawings are submitted to the *Project Manager* for review and acceptance. Manuals are in English and each manual is complete with the Power Station’s name, contract number and index. The *Contractor* shall also provide an electronic copy of these documents.

The manuals should indicate the level of responsibility of the operating personnel for each action in the procedures. Included in these manuals are the following:

1. Design data including descriptions of control philosophy with alarms, set-points, interlocks and logics clearly explained.
2. Process and instrumentation diagrams.
3. Range, calibration factors, calibrations certificates, data sheets, etc., for all control and instrumentation equipment.
4. Electrical diagrams.
5. General arrangement and installation drawings and instructions.
6. Operating procedures and instructions for normal and emergency conditions, including flow diagrams.
7. Maintenance procedures and instructions for specific plant and equipment.
8. All drawings required for component location, dismantling and re-assembly for maintenance.
9. Equipment details such as make, model, type, specifications, etc.
10. Detailed parts lists and ordering instructions pertaining to storage of spare parts or to their shelf life.
11. Exploded view type drawings clearly detailing the part and uniquely identifying it, technical descriptions of the equipment and component parts.
12. Catalogues, schedules and other product support documents.
13. Troubleshooting and fault finding guide.
14. Safety procedures and instructions.
15. All special tools and equipment required for maintaining and operating the *works*.

The maintenance manuals shall be separated into mechanical, electrical and C&I volumes.

The technical manuals shall include fully detailed descriptions, as-built drawings, diagrams, illustrations, schedules and data for use by Eskom technical staff to evaluate performance, trace faults, adjust, maintain and fully understand the plant and to allow satisfactory training of junior staff in conjunction with the operating manuals.

The operating manuals shall be set out in simple terms in ordinal, tabular or pictorial form to provide factual and concise descriptions of:

1. How to carry out start-up, shut-down, and service operation of the plants by automatic, semi-automatic and by manual control.
2. What happens when the plants are operated, e.g. where does the water, chemical, air, etc. flow when a sequence is initiated or a valve is operated.
3. What an alarm condition implies and how it is corrected.
4. What problems can occur and how they are overcome.
5. A routine visual plants inspection procedure.

The operating manuals are intended for daily use and therefore shall be separated from the technical and maintenance manuals. Bold print, diagrams, illustrations, etc. shall be used.

The maintenance instruction manuals shall include schedules to cover plant inspection procedures, fully detailed maintenance programmes for plant and plant equipment services at daily, monthly, three monthly, six monthly, yearly and any other necessary intervals, and contain manufacturer’s and supplier’s detailed maintenance and lubrication instructions, diagrams, sectional drawings giving part numbers, descriptions,

etc. Where spare parts have been provided theses should be coloured in, scheduled, and their filling procedure described. The manual shall also include minimum surveillance requirements for the plant.

Detailed maintenance procedures, covering removal, dismantling, replacement of parts, re-erection, checking, and reassembly and re-commissioning shall be included for all equipment. The re-commissioning shall be included for all equipment. The maintenance manual shall be fully comprehensive and cover all plant and materials installed. As the manuals shall be frequently used for training and maintenance, they shall be prepared similarly to those described for the operating instruction manuals for use by operating personnel.

2.9 PLANT AND MATERIALS

2.9.1 Quality

The *Employer* places emphasis on the provision of a comprehensive Quality Management System (QMS) for all phases of the project in accordance with QM-58. The QMS shall comply with the requirements of ISO 9001. The *Contractor* and all of the *Contractors'* suppliers shall hold a valid certificate of compliance for their QMS to the requirements of ISO 9001:2008. The *Employer* may at his sole discretion carry out an audit any supplier or sub-supplier QMS for compliance.

Documents shall be submitted for review and acceptance by the *Project Manager* prior to the commencement of work.

The *Contractor* shall submit a fully detailed Quality Control Plan / ITP for acceptance within four weeks of the Contract Date.

No work is allowed on Site unless the *Employer* accepts the Quality Control Plan.

The *Contractor* shall utilise the *Employer's* quality documentation forms for requesting access, erection checks etc. These request forms are to be submitted to the *Supervisor* at least one week prior to the requested activity, or as agreed to by the *Project Manager*.

Apart from any statutory data packages required, the *Contractor* shall also compile a data package of the relevant drawings, test certificates etc. for each section of work which is to be reviewed and signed off by the *Supervisor* at erection stage prior to the commencement of the commissioning phase.

2.9.2 Plant & Materials provided "free issue" by the *Employer*

No "free issue" items shall be supplied. All Plant and Materials are to be provided by the *Contractor*.

2.9.3 *Contractor*'s procurement of Plant and Materials

The *Contractor* shall procure all Plant and Materials required for constructing, installing and commissioning the *works*.

The *Contractor shall*:

1. Advise the *Project Manager* in advance of all major shipments of Plant and Material and co-ordinates with the *Employer* the arrival, off-loading and release of such. The *Contractor* shall promptly unload shipments and promptly releases carrier equipment.
2. Notifies the *Project Manager* of being unable to promptly unload any shipment not less than 5 (five) days prior to arrival. The *Project Manager*, at his option, off-loads or makes arrangements for others to off-load such shipments for the account and risk of the *Contractor*. Costs incurred in respect of off-loading shall be for the *Contractor*'s account.

3. Ensures that all the Plant and Materials are inspected. The *Contractor* shall notify the *Project Manager* who instructs designated *Employer*'s representatives to inspect the Plant and Materials at the factory, or the *Contractor*'s premises, before it is transported to the Site.
4. Ensures that all relevant factory tests are witnessed and accepted by the designated *Employer*'s representatives. Any deviations from accepted drawings, standards or specifications are noted and reported to the *Contractor* by the above mentioned representatives. A copy of the deviations is forwarded to the *Project Manager* for record keeping. The *Project Manager* follows up with the *Contractor* to ensure that deviations are successfully corrected.
5. Submits calibration certificates of all test equipment used for testing of any electrical equipment to the *Project Manager*.

2.9.4 Spares and consumables

The *Contractor* shall supply, on acceptance by the *Project Manager*, a set of spares considered to be essential as part of the *works*.

The *Contractor* shall submit, on completion of the design, a detailed listing of the recommended spares and prices for the *Project Manager's* acceptance to comply with the aforementioned requirement. The prices quoted shall include for packing, delivery to and off-loading at site, inspection and testing and adequate protection against corrosion, damage and weathering during transit and storage.

2.10 TESTS AND INSPECTIONS BEFORE DELIVERY

The *Employer* carries out quality inspections at his discretion.

All inspections and testing to be performed in accordance with the Quality Control Procedure (QCP) developed by the *Contractor*.

The *Employer* shall be provided access to the *Contractor's* premises for the purpose of:

1. Establishing compliance with the contractual requirements by means of inspections, surveillance and audits.
2. Witnessing the performance of any tests.

The *Employer* shall inspect switchboards or panels forming part of the Plant before they are released from the *Contractor's* premises at his discretion. This inspection entails a thorough check to ensure complete compliance with this specification including schedules, design drawings and other applicable standards.

The *Contractor* shall obtain clearance from the *Employer* or the *Employer's* agent before despatching of the equipment. This factory release inspection does not release the *Contractor* of any of his obligations under the contract.

No Plant shall be released for dispatch without the AS MANUFACTURED documentation and drawings accompanying them.

2.11 MARKING PLANT AND MATERIALS OUTSIDE THE WORKING AREAS

All equipment to be safely stored as per the OHS Act.

All plant and equipment to be removed from the designated area can only be removed with the permission of the *Contractor* and *Project Manager*.

2.12 *CONTRACTOR*'S EQUIPMENT (INCLUDING TEMPORARY *WORKS*).

The *Contractor* shall be liable for all plant & equipment in the designated area under his control. The *Employer* shall not take any responsibility for any loss or damage to the equipment.

3. CONSTRUCTION

3.1 TEMPORARY *WORKS*, SITE SERVICES & CONSTRUCTION CONSTRAINTS

3.1.1 *Employer*'s Site entry and security control, permits, and Site regulations

All the *Contractor's* employees shall be required to attend a safety induction course before they shall be allowed to work on the Site. It shall be the responsibility of the *Contractor* to ensure that all employees have attended the safety induction. The *Contractor* shall compile his safety file for approval at the safety officer. The safety officer shall first approve this file, before the *Contractor* can attend the safety induction course.

A list of employees requiring safety induction shall be submitted at least 2 days in advance of arrival on site with the date and time of arrival so that safety induction can be arranged.

Site access control to Duvha Power Station shall be arranged with the *Project Manager* after successfully completing the safety induction course.

Alcohol testing shall be conducted at any time on all employees entering the Duvha Power Station premises. All staff that tested positive for alcohol abuse shall not be allowed on site.

3.1.2 Restrictions to access on Site, roads, walkways and barricades

All vehicles shall comply with the Road Traffic act.

Vehicle inspections shall be conducted on a daily basis and check sheets shall be kept at the *Contractor's* offices.

3.1.3 *Contractor*'s Equipment

1. The *Contractor* shall provide all Equipment that is required to complete the *works*.
2. The *Contractor*'s Equipment shall not impair the operation or access to the plant.
3. The *Contractor* shall provide all or any temporary or expendable materials required for the storage of material.

Any Equipment, or appliances, used by the *Contractor* shall conform to the applicable OHS Act safety standards and is maintained in a safe and proper working condition. The *Project Manager* has the right to stop the *Contractor*'s use of any Equipment which, in the opinion of *Project Manager*, does not conform to the foregoing.

Off-loading and material handling Equipment such as cranes and fork lifts are available on Site (within the station's security fence) and shall be arranged with the *Project Manager* if required by the *Contractor*. Off-site requirements for cranes and fork lifts are not provided by the *Employer* and shall be arranged by the *Contractor* at his own expense.

The *Contractor* shall submit a list of all tools and equipment entering site. Equipment and tools not declared shall become the *Employer*'s property.

On completion of the project, all tools and equipment shall be removed only with permission from the *Project Manager* on the applicable approved *Employer* documents.

3.1.4 Site services and facilities

3.1.4.1 Supply of electricity

All points of supply requested by the *Contractor* are provided in terms of quantity and location at the discretion of the *Project Manager*.

There is no energy charge for electricity used for construction purposes.

No connection is made to the permanent installation at the Power Station without the prior acceptance of the *Project Manager*.

No guarantees of power supply quality are given and power supply breaks of some duration may occur without warning. Planned outages are also a possibility. The *Contractor* shall make arrangements at his own expense to improve continuity and quality of power where necessary for any reason and no claim of any nature relating to power failures is considered.

All electrical work shall have a valid Certificate of Compliance (COC).

3.1.4.2 Roads

Main access roads are surfaced and complete and may be used by the *Contractor* with the necessary care. The *Employer* maintains the Site roads, described above, to a fair condition. Any costs incurred by the *Project Manager* from damage caused to underground services, structures, etc. as a result of the *Contractor* not using the prescribed routes is recovered from the *Contractor*.

3.1.4.3 First aid and fire fighting

The *Contractor* in cases of emergencies or accidents shall call upon the services of the first aid and fire fighting resources at the Duvha Power Station.

3.1.4.4 Sanitary facilities

The *Employer's* sanitary facilities are used as directed by the *Project Manager*.

3.1.5 Facilities provided by the *Contractor*

3.1.5.1 Lay down areas

No Plant, Material and Equipment lay down areas are permitted on the terrace. The *Contractor* shall *deliver* all Plant, Materials and Equipment to the point of erection as and when needed. Plant, Materials and Equipment not used within 14 days are removed from the terrace and stored in the site yard.

3.1.5.2 Security

The *Contractor* shall provide security necessary for the protection of the *works* at all times until the Completion of the whole of the *works*.

The *Contractor* shall be informed of the access procedures through Site Regulations and note that such procedures may change depending on the prevailing security situation.

All persons entering the site pass through the control points at the main access gate and shall be required to have temporary permits that are issued to *Contractor's* staff on request. If it is necessary to bring Equipment onto site a list is submitted which is verified by security staff prior to Equipment entering the security area.

No firearms, weapons, alcohol, illegal substances and cameras (including cell phones with cameras) are permitted on Site.

The generator area and the other units are barricaded and out of bounds and only authorised persons are permitted. Areas outside the Site are out of bounds to the *Contractor's* staff.

3.1.6 Giving notice of work to be covered up

All intended activities shall be captured in the scope of *work* and also on the project schedule. The project schedule shall be reviewed and updated weekly.

3.2 COMPLETION, TESTING, COMMISSIONING AND CORRECTION OF DEFECTS

3.2.1 Work to be done by the Completion Date

The entire *works* shall be completed by the agreed upon completion date including commissioning and testing.

3.2.2 Use of the *works* before Completion has been certified

The effluent system is integral to the operation of the Power Station and cannot be entirely decommissioned. The *Contractor* therefore shall provide a method statement to indicate how take-over of certain parts of the *works* may be accomplished before the agreed upon completion date to ensure continuous operating capacity of the effluent system is maintained. Section 2.2.4.6 describes the envisaged construction methodology that would allow for the required continuous operating capacity of the effluent system.

3.2.3 Commissioning

Commissioning of the *works* shall be done by the *Contractor's* staff with the *Employer's* dedicated operations/commissioning staff.

The *Contractor* shall submit a commissioning schedule and program for acceptance by the *Project Manager* by the Contract Date.

Before plant and equipment is placed in service the *Contractor* shall certify that it is in a suitable and safe condition. In addition, the *Contractor* shall provide a complete list of numbered schematic, wiring and cable diagrams which are a true record of the plant and equipment as installed and certifies that the *works* has been wired in accordance with these diagrams.

Prior to the time when commissioning is to commence, the *Project Manager* shall appoint a representative who shall co-ordinate the commissioning of all plant and equipment forming an integral part of the system being commissioned. The *Contractor* shall be responsible for the commissioning of all the plant and equipment he/she is to supply to the requirements of this specification in conjunction with the *Project Manager* and the *Employer's* C&I representatives. Where various components are already in place, or are supplied by the *Employer* to form an integrated system, the *Contractor* at the time of commissioning, shall carry the responsibility for the correct functioning of the whole system.

In the event of incorrect functioning, the *Contractor* shall determine the cause and he/she corrects the Defect if the Defect is within Plant and Equipment of his/her own supply. The *Contractor*, at the time of commissioning, shall have the agreement, or alternatively, the attendance of the *Project Manager* involved in a particular phase, before proceeding with commissioning. Consequently, the *Contractor* shall assure himself/herself as to the safety of his/her own Plant and Equipment in respect of any particular commissioning test and in the event of damage accept responsibility for such Plant and Equipment.

The *Contractor* shall commission the *works* and ensures conformance to the *Employer's* performance requirements for the *works*. The *Employer* takes over sections of the system as required once the system performance requirements have been verified by the *Contractor*.

3.2.4 Start-up procedures required to put the *works* into operation

The plant shall be put in operation after safety clearance of certain parts of the plant and systems as described in Section 2.2.4.6 and Section 3.2.

Sign off shall be scheduled as per the project schedule on completion of each activity.

3.2.5 Take over procedures

Take-over / hand over shall be scheduled as per completion.

3.2.6 Access given by the *Employer* for correction of Defects

The defects period is 52 weeks from completion of the entire *works*. Any defects shall be rectified within this period at the expense of the C*ontractor* and at the convenience of the *Project Manager.*

3.2.7 Performance tests after Completion

Acceptance tests shall be carried out to prove all the plant guarantee figures provided by the *Contractor* in the technical schedules. The *Contractor* shall provide his own testing equipment.

Where the results of the performance tests performed don't correlate with expected results (flow rates, pressures etc.) and/or the control functions as per the operating philosophy do not meet the specifications guaranteed, the *Contractor*, at his own expense, shall carry out all necessary adjustments and modifications to the *works* required to obtain the stated tolerances. Fully detailed proposals are submitted in writing to the *Project Manager* for acceptance before any adjustments and modifications are made and work in this respect is carried out when convenient to the *Project Manager*. All adjustments and modifications are subject to inspection and approval by the *Project Manager*.

When adjustments and modifications are completed, the *Contractor* shall advise the *Project Manager* in writing to this effect and applies for a further acceptance test. From the results obtained, and provided that the *Employer* is satisfied that it shall be lasting, the *works* shall be finally accepted by *Project Manager.*

3.2.8 Training and technology transfer

The Contractor shall provide training to the operating staff and engineering department of the *Employer*. All Operating & Maintenance requirements to be included in the training manuals.

3.2.9 Operational maintenance after Completion

Not applicable.

4. PLANT AND MATERIALS STANDARDS AND WORKMANSHIP

4.1 BUILDING *WORKS*

1. The *Contractor* shall be responsible for the design, erection, maintenance and removal of all temporary bracing or propping required for the execution of the *works*.
2. The *Contractor* shall adhere to the Eskom Standards and should these be unavailable, the relevant SANS standard shall apply.
3. The *Contractor* shall provide all relevant welding procedures for acceptance to the *Project Manager*.
4. The *works* described in this scope include the following:

4.1.1 Investigation, survey and Site clearance

1. The *Contractor* shall be responsible for the complete surveying and setting out of the *works* including establishment of any benchmarks required to complete the *works*. Any discrepancies noted are to be brought to the attention of the *Project Manager* prior to commencement of construction.
2. The *Contractor* shall consult the surveyor-general office to obtain information on available registered beacons near Duvha Power Station to use for the establishment of any required benchmarks close to the *works*.
3. The *Contractor* shall submit as-built data and drawings of the completed *works* to the *Project Manager* upon handover. As-built drawings are submitted in PDF and native CAD (.DGN) formats.

4.1.2 Construction and erection phase

1. The *Contractor* shall construct and erects the *works* in accordance with the *Employer*'s approved design.
2. All *works* shall be performed in accordance with the *Contractor*'s accepted Quality Control Plan. All construction and erection work conducted on the site shall be subject to inspection by the Supervisor.
3. The construction and erection of the *works* shall be performed under the supervision of the Supervisor. An acceptance/test schedule shall be compiled by the *Contractor* and approved by the Supervisor.
4. All equipment required for the erection and completion of the *works* shall be supplied by the *Contractor*. This Equipment shall be in good condition and subject to the *Employer*'s safety requirements.
5. The *Contractor* shall supply all Plant and Materials where new Plant and Materials are required for the completion of the *works*.
6. All Plant and Materials used shall comply with the requirements regarding quality, method of manufacturing, testing and performance specification as given in the relevant SABS/SANS specification, or where such a specification does not exist, the requirements of the relevant British or ISO standard. All plant and materials shall be suitable for use or operation under the operating conditions applicable to the system.

4.1.3 Restricted Working Conditions

The erection of any temporary *works* such as formwork is subject to acceptance of the *Supervisor*. The *Contractor* shall take all necessary precautions to ensure that no damage to any existing plant and equipment takes place during the *works.* The *Contractor* shall supply all equipment necessary for the construction of the *works*. The *Contractor* shall take cognisance of existing plant and equipment as well as safety and housekeeping constraints. It is the *Contractor's* responsibility to overcome any issues that may arise due to space constraints with prior consent from project management and no extra payment or claim of any kind shall be allowed on account of difficulties of access to the *works.*

4.2 CIVIL ENGINEERING AND STRUCTURAL *WORKS*

4.2.1 Civil and Structural Standards

- 240-56364545: Structural Design and Engineering Standards
- SANS 1200 Series: Civil Work Standards
- SANS 2001 Series: Construction Work
- SANS 10100-1&2: The structural use of concrete Part 1 & 2
- SANS 10102-1&2: The selection of pipes for buried pipelines Part 1 & 2

4.3 ELECTRICAL & MECHANICAL ENGINEERING *WORKS*

4.3.1 Electrical Standards

The applicable electrical Standards / Codes for this project are based but not limited to the following:

- 240-56227516: LV Switchgear Control Gear Assembly Associated Equipment for Voltage 1000V and 1500V Standard.
- 240-56227443: Requirements for Control and Power Cables for Power Stations Standard.
- 240-56357424: MV and LV Protection Standard.
- 240-56356396: Earthing and Lightning Protection Standard
- 240-57617975: Procurement of Power Station Low Voltage Motors Specification
- 240-56361435: Transport of Power Station Electric Motors Standard
- 240-56360387: Storage of Power Station Electric Motors Standard
- SANS 1973: Low Voltage switchgear and Control gear Assemblies
- SANS 10142: The wiring of Premises
- SANS 1804-2: Induction motors Part 2 : Low-Voltage three phase Standard motors

4.3.2 Mechanical Standards

- GGSS 0423: Specification for Low Pressure Valves
- GGSS 0690: Specification for Medium Pressure Pipelines
- ESKSCAAB8: Specification for Corrosion protection for mechanical items of plant.

- GGSS 0407: Steelwork and Welding
- SANS 62-1 (6-150NB): Screw pieces and pipe fittings of nominal size not exceeding 150mm
- SANS 62-1 (6-150NB): Pipes suitable for threading and of nominal size not exceeding 150mm.
- SANS 719 (200-600NB): Electric welded low carbon steel pipes for aqueous fluids (large bore).
- SANS 4427: Plastics piping systems – Polyethylene (PE) pipes and fittings for water supply.

4.4 PROCESS CONTROL AND IT *WORKS*

4.5 GENERAL STANDARDS

- Occupational, Health and Safety, Act Number 85 of 1993
- 240-49230111: Hazard and Operability Analysis (HAZOP) Guideline (Rev 1)
- 240-30008949: Safety, Health and Environmental Specifications for *Contractor*s
- 240-28463367: SHE Organization
- 240-62196227: Life Saving Rules

5. CONFIGURATION AND DOCUMENTATION MANAGEMENT

5.1 DOCUMENTATION MANAGEMENT

5.1.1 General Requirement

The Contractor includes the Employer's document number in the title block. This requirement only applies to design documents developed by the Contractor and his Subcontractors. It does not apply to documents developed by manufacturers for equipment and material such as valves, instruments, etc.

The project name shall be listed on all documents, including manufacturers' drawings. Tag numbers and equipment names shall be listed on all manufacturers' drawings. A separate sheet may be attached to the submittal if needed to adequately list all tag numbers associated with the drawings such as valves or instruments which may have numerous tag numbers associated with it.

The language of all documentation shall be in the English language. The units of measure shall be metric.

The Contractor retains project design calculations and information for the entire life cycle of the plant and provides these to the Employer on prior written notice at any time notwithstanding the expiry or termination of the contract.

5.1.2 Document identification

The *Contractor* shall be required to submit the Vendor Document Submission Schedule (VDSS) as per agreed dates with the delegated *Employer's* Representative. The *Project Manager* shall pre-allocate document numbers on the VDSS if possible and send back to the *Contractor* through the delegated *Employer's* Representative. The VDSS is revisable and changes shall be discussed and agreed upon by all parties. Changes in the VDSS can be additional documentation to be submitted, changes in submission dates or corrections in documentation descriptions, document numbers, etc. The *Contractor* shall provide his own document numbering system for the VDSS.

5.1.3 Documents Submission

The email subject shall as a minimum have the following:

(Project Name_Discipline_Subject)

The Contractor submits documentation to the Eskom Representative copying the Project's Documentation Centre in the following media:

- Electronic copies will be submitted to Eskom Documentation Centre through generic email address (drmsharedservices@eskom.co.za) Electronic copies large for email will be delivered on CD/USB Stick, large file transfer protocol and/or hard drives to the Project Documentation Centre. A notification email, with the transmittal note attached, shall be sent to the project generic email address. The Representative will be copied on the email as well.

- Hard copies shall be submitted to the Eskom Representative accompanied by the Transmittal Note.

5.1.4 Drawings

The creation, issuing and control of all Engineering Drawings will be in accordance to the latest revision of 240-86973501 (Engineering Drawing Standards – Common Requirements) to be supplied as part of the enquiry documents. An electronic copy of all drawings shall be issued to the *Project Manager*. All

Contractors are required to submit electronic drawings in Micro Station (DGN) format, and scanned drawings in pdf format. No drawings in TIFF, AUTOCAD or any other electronic format shall be accepted. Drawings issued to Eskom may not be “Write Protected” or encrypted. The Contractor shall supply the Project Manager with a complete list of drawings, upon which the Project Manager will supply Eskom drawing numbers.

5.1.5 Naming of files

The Contractor will comply with the Eskom standard for naming documentation files. The standard is as follows:

For documents that have approval date and signature

(*YYYYMMDD_DocType_DocumentTitle_UniqueIdentifier_Revision.FileExtention)*

For documents that do not necessarily require the ‘Approved Date’ and ‘Revision & Versioning’, use the date of update

(*YYYYMMDD_DocType_DocumentTitle_UniqueIdentifier_Revision.FileExtention)*

5.2 CONFIGURATION MANAGEMENT

5.2.1 Plant Coding Allocation

Coding of the design shall be based on the AKZ coding system and the *Project Manager*shall undertake the coding in line with its standards. The AKZ coding shall be applied during the design review stage(s) and cross referenced to all arrangement drawings, schematics, wiring diagrams, instructions and manuals and where practical to spare parts list/manuals. The *Contractor* shall be required to include allocated coding to the electronic design drawings.

5.2.2 Plant Labelling

The *Contractor* shall also manufacture and install AKZ labels to identified plant items as per list supplied by the *Employer*. Labels shall be manufactured and installed according to the *Employer’s* AKZ Plant Labelling and Equipment Descriptions Standard. The labeling standard shall be supplied as part of the enquiry documents.

5.2.3 General Requirement

The Contractor includes the Employer’s drawing number in the drawing title block. This requirement only applies to design drawings developed by the Contractor and his Subcontractors. It does not apply to drawings developed by manufacturers for equipment and material such as valves, instruments, etc. Drawing numbers will be assigned by the Employer as drawings are developed.

The project name shall be listed on all drawings, including manufacturers’ drawings. Tag numbers and equipment names shall be listed on all manufacturers’ drawings. A separate sheet may be attached to the submittal if needed to adequately list all tag numbers associated with the drawings such as valves or instruments which may have numerous tag numbers associated with it.

The language of all documentation shall be in the English language. The units of measure shall be metric.

The Contractor retains project design calculations and information for the entire life cycle of the plant and provides these to the Employer on prior written notice at any time notwithstanding the expiry or termination of the contract.

5.2.4 Configuration Management

The Contractor supplies a comprehensive configuration management program according to ISO 10007 (2nd Edition) to ensure that plant structures, components and computer software conform to approved design requirements. However a project specific Configuration Management Plan document will be developed which will be aligned to ISO 10007. In addition, the Works as-built physical and functional characteristics shall be accurately reflected in selected documents and databases, including those for design, procurement, construction, operation, testing and training. The configuration program shall be applicable for use throughout all phases of the project life cycle, including management of spare parts, replacement parts and product upgrades, and shall form part of deliverables for hand-over to the Employer for use during the operation and maintenance phases of the plant.

5.2.5 Change Management

All Design change management shall be performed in in line with the Eskom Project Change Management Procedure (240-53114002) and the Employer ensures that Contractor is provided with latest revisions of this procedure. Any uncertainty regarding this procedure should be clarified with the Employer and clarification updates should be reflected in updated versions of this procedure.

5.2.6 Design Review Documentation

The Contractor conducts design reviews as per the Contractors official design review procedure. Contractor further takes note of the Employers Design Review Procedure (240-53113685) and participates in all design reviews as specified by the Employer. The Employer may “Accepted”; “Accept with Comments” or “Rejected”. If required, the Contractor makes the necessary revisions on the documentation and ensures acceptance is obtained from Employer. The Contractor includes these design reviews as part of the schedule and suggests appropriate timing for such reviews.

6. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Sibonokuhle Tapala	Senior Engineer: Auxiliary Engineering Duvha PS
Sumayyah Sulliman	Chief Engineer PEIC: Duvha PS
Yamkela Mgwebi	System Engineer Chemical: Duvha PS
Thilivhali Muthakhi	System Engineer Civil: Duvha PS
Lethukuthula Ndwandwe	System Engineer C&I: Duvha PS
Thokozani Xulu	System Engineer Electrical: Duvha PS
Alisha Surjoobhalee	Technician Configuration: Duvha PS
Siyasanga Dayile	Configuration Management: Duvha PS
Nokwazi Base	Senior Advisor Projects: Duvha PS
Cecil Mngqibisa	Senior Chemist Water Treatment Plant: Duvha PS
Sonwabo Xaba	Senior Advisor Technical Support: Duvha PS

7. REVISIONS

Date	Rev.	Compiler	Remarks
June 2016	0.1	PF Roux	Draft.
July 2016	01	PF Roux	Final document.
November 2024	02	Y Mgwebi	Revised based on time & change of engineering resources

8. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Philipp Roux
- Nomfundo Mdlokovana
- David Kunene
- Mishack Mdluli
- Kellie Kwinika
- Alicia Simbudayal

9. ACKNOWLEDGEMENTS

- Nishad Aboobaker
- Trivesh Moodley

APPENDIX A: PIPELINE DETAILS

Table 1: Pipeline details list

Equipment List						
Equipment	**Equipment number**	**Diameter (mm)**	**Quantity**	**Schedule**	**Material**	**Specification**
Pipe		100 NB (114 x 3.05 x10s)	7 metre length	10s	316L Stainless steel, seamless pipe	ASTM A312
		200 NB (219.1 x 3.76 x10s)	100 metre length	10s	316L Stainless steel, seamless pipe	ASTM A312
		200 NB	1528 metre length	SDR26	HDPE	CLASS 6 PN6.3
Reducers						
		100 NB to 200 NB	3	10s	316L Stainless steel, seamless pipe	ASTM A312
Tee piece		200 NB straight Tee, butt welded	3	10s	316L Stainless steel	ASTM A312
Bends		100 NB long radius	5	10s	316L Stainless steel, seamless pipe	ASTM A312
		200 NB long radius	6	10s	316L Stainless steel, seamless pipe	ASTM A312
Flange		100 NB	6	Type 3, raised face	316L Stainless steel	SANS 1123
		100 NB	3	Type 3, raised face	316L Stainless steel	SANS 1123
		200 NB	6	Type 3, raised face	316L Stainless steel	SANS 1123
Gaskets		100 NB	3	3mm thick	Aramid fibres	Full face
		200 NB	4	3mm thick	Aramid fibres	Full face
Valves	Pressure Relief Valve	100 NB PRV	3	N/A	Stainless steel, PN 16, flanged ends	316L
	NRV	200 NB Swing check valve	3	N/A	Stainless steel, screwed	316L
	ISOLATION VALVES	200 NB Butterfly valve	3		Stainless steel, wafer type	316L

Notes:
All piping is seamless
All valves should be rated at a minimum of 16 bar/ 1600 kPa
All flanges and valves that are flanged must correspond to SANS 1123 type 3 flanges (raised face) rated at 1600 kPa

APPENDIX B: EFFLUENT WATER SYSTEM GENERAL ARRANGEMENT ISOMETRIC DIMENSIONS - DETAIL 1

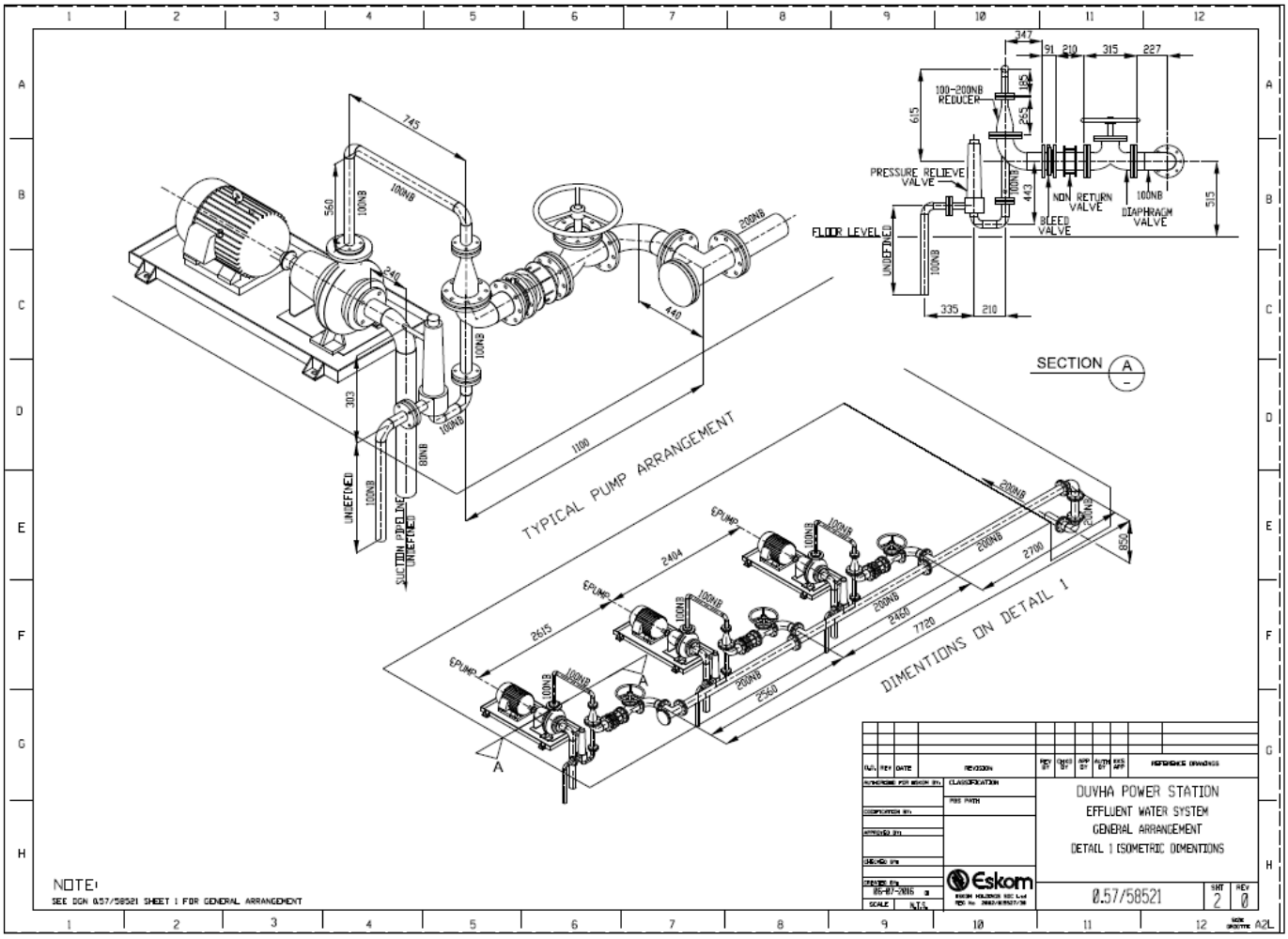

Figure 1: Effluent water system general arrangement isometric dimensions – Detail 1

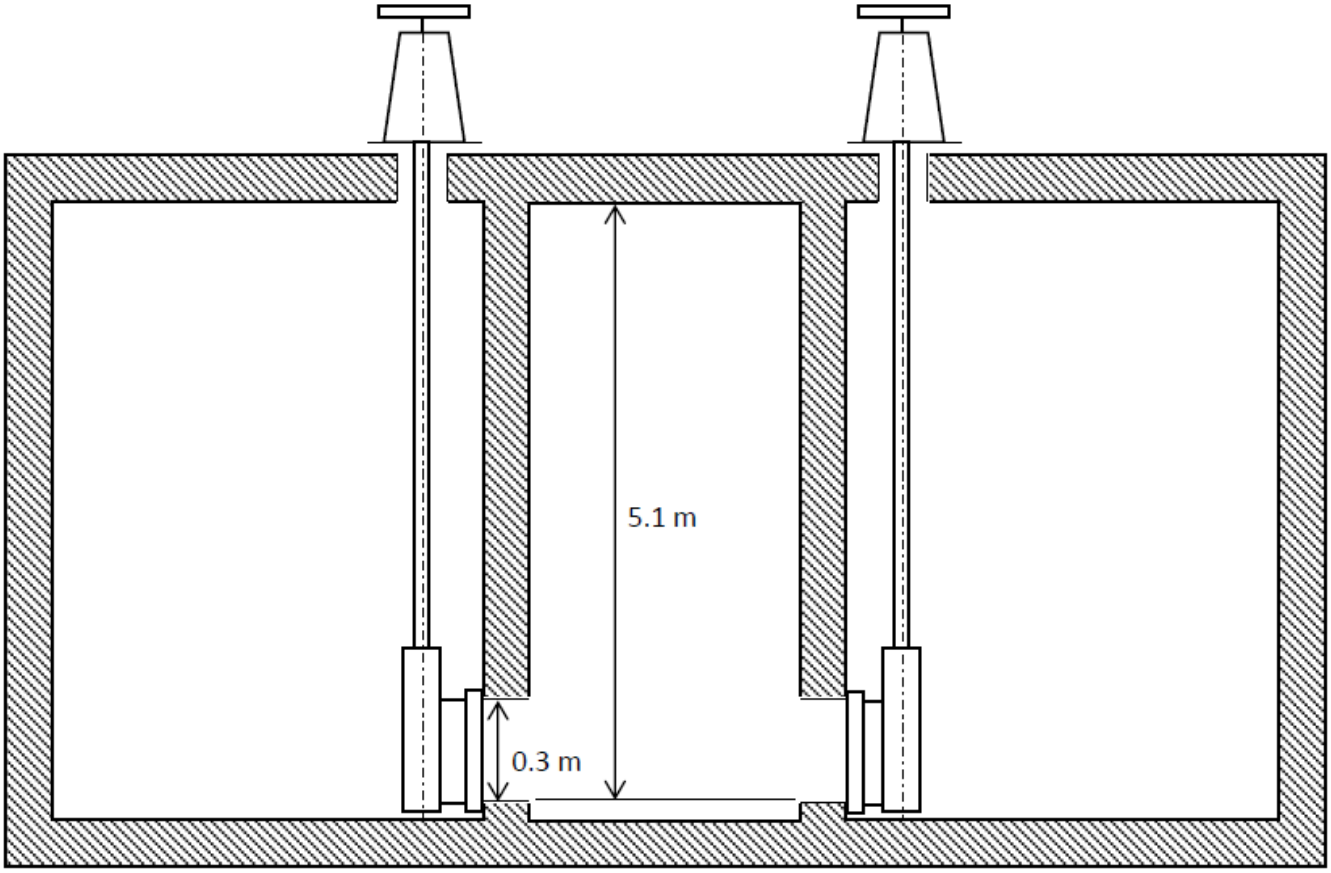

Figure 2: Schematic representation of the side view of the effluent sump showing interconnection valve or slide gates

APPENDIX C: EFFLUENT WATER SYSTEM GENERAL ARRANGEMENT

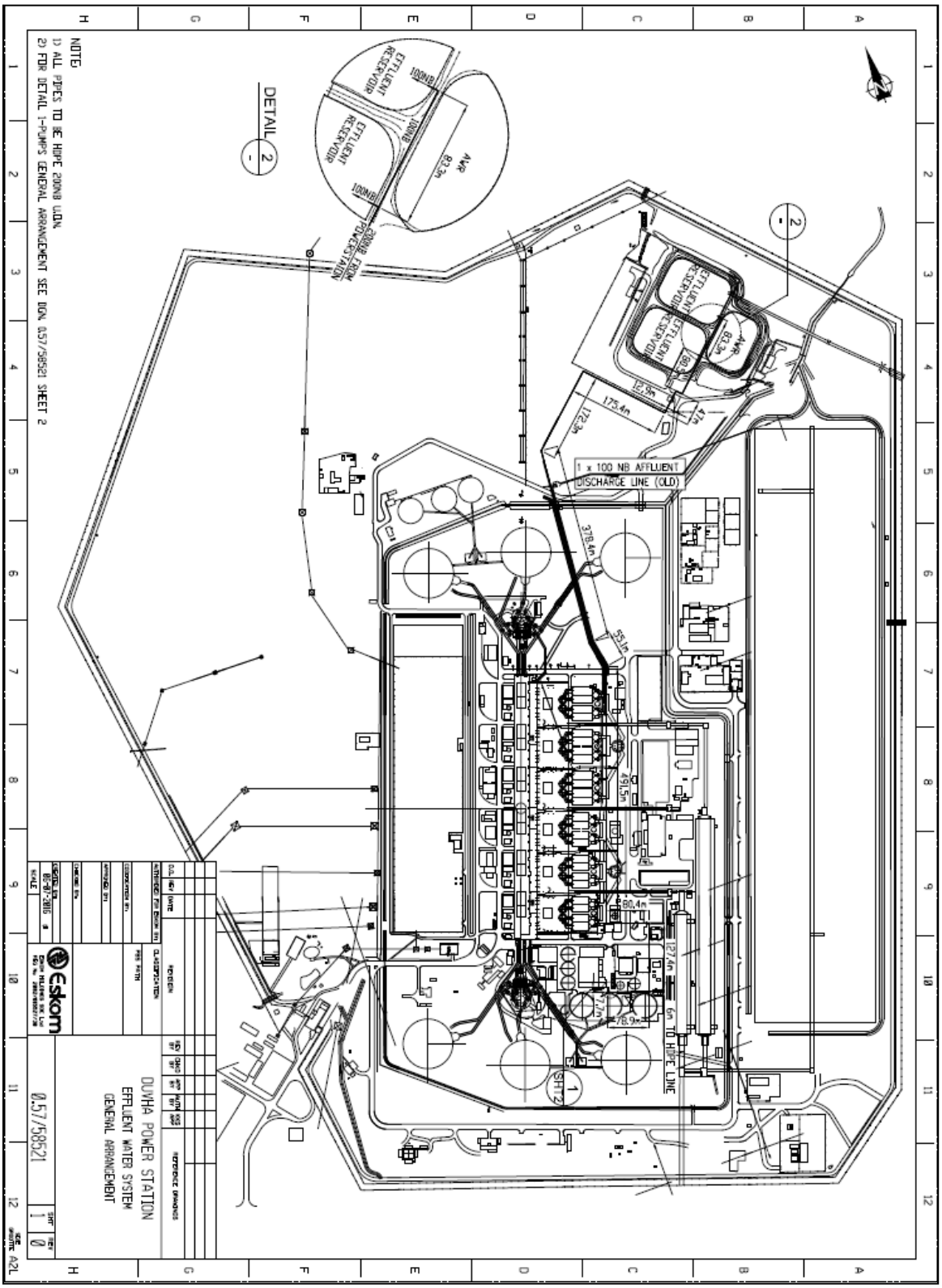

Figure 3: Eluent water system general arrangement

APPENDIX D: TECHNICAL DATA SHEET FOR UPGRADED PUMPING SYSTEM

KSB Ref: 4002749994-2 Project: Tag Nr:	**Technical Data Sheet** **OMEGA 80-210A**	

Operational data

Fluid	Wastewater		Nominal flow	125.00 m³/h	
Operating temperature t A	20	°C	Nominal head	35 m	
Density at t A	0.998	kg/dm³	Static head	0 m	
Vapor pressure	0.022	bar	Available system NPSH		
Kin. viscosity at t A	1	mm²/s			

Pump

Manufacturer		KSB SA	Flow	Nominal	125.4 m³/h	
Pump name		OMEGA 80-210A	Head	Nominal	35.2 m	
Impeller Ø		171 mm	Head H(Q=0)		43.5	m
Suction port	Nominal size	125 mm	NPSH 3%		3.67	m
	Nominal pressure	16 bar	Shaft power		15.60	kW
	Standard	DIN 2533	Efficiency		77.4	%
Discharge port	Nominal size	80 mm	Speed		2900	1/min
	Nominal pressure	16 bar	No. of stages		1	
	Standard	DIN 2533	Weight		185 kg	

Shaft seal

Manufacturer		Material code	
Type			

Materials

	Pump		Shaft seal		
Volute Casing	Cast Iron				
Impeller	316 St Steel				
Shaft	Chrome Steel				
Shaft Sleeve	Chrome Steel				
Seal	Packed Gland				
Wear Ring	Chrome Steel				

Motor

* Efficiency

Manufacturer		Rated current*	A
Motor type		Efficiency*	%
Motor name		Power factor*	
Size		Protection	
Frequency	Hz	Design standard	
Power	kW	Insulation class	
Nominal speed	1/min	Weight	
Rated voltage	V		

Coupling

Manufacturer		Spacer length	
Coupling type			
Coupling name			

Baseplate

Type		Size	
Anti Vibration		Weight	

APPENDIX E: PUMP CURVE FOR UPGRADED PUMPING SYSTEM